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Keywords Quality of life · ADHD · Adults · Sluggish cognitive tempo

Attention-Deficit/Hyperactivity Disorder (ADHD) is considered a persistent neurobiological disorder, with ADHD traits continuing into adulthood in approximately 60–78 % of diagnosed children and adolescents (Biederman et al. 2010; Sibley et al. 2012;

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Sobanski et al. 2008) and approximately 4.4 % of adults in the United States demonstrating adequate symptoms to merit an ADHD diagnosis (Kessler et al. 2006). Sluggish cognitive tempo (SCT; characterized by sluggishness, passivity, confusion, and hypoactivity) is a attentional-motivational construct that has historically been proposed to be associated with a non-hyperactive type of ADHD (Carlson and Mann 2002; Marshall et al. 2013; McBurnett, Pfiffner, & Frick, 2001), but more recently has been posited as a distinct impairment that is often comorbid to ADHD (Barkley 2012; Becker 2013). In fact, there is research to support the co-occurrence of SCT and IA symptoms in up to 68 % of adults with ADHD, and it is likely that adults with comorbid ADHD and SCT suffer even greater impairment than those with ADHD alone (Barkley 2012). SCT is neither included as a stand-alone diagnostic category nor in the ADHD criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (fifth edition; *DSM-5*; American Psychiatric Association 2013). However, the extant research suggests a need to further investigate how sluggish cognitive tempo manifests with ADHD in *adulthood* (Garner et al. 2010) and how the former relates to quality of life, with the sole published foray into this area having omitted specific examination of the latter (Barkley 2012).

The Centers for Disease Control and Prevention (CDC 2009) describes health-related quality of life (QOL) to be a personal perception of physical and mental health and well being throughout the lifespan. While the literature in this area is not extensive, ADHD has been associated with impaired QOL in children (Riley et al. 2006; Wehmeier et al. 2010) and adults (Ableetal. 2007; Das et al. 2012; Lensing et al. 2013). As QOL of individuals with ADHD has become more of a research focus in recent years, several measures have emerged which specifically examine this construct in the ADHD population (see review in Agarwal et al. 2012). While empirical evidence for QOL deficits in ADHD is mounting, mere consideration of the range of common impairments associated with the disorder reinforces that this is an issue worthy of further investigation. Academic and learning difficulties are common for individuals with ADHD, regardless of age (Loe et al. 2008; McConaughy et al. 2011), when compared to peers without the disorder. In addition, research has indicated that college students with ADHD demonstrate more difficulty with motivation and information processing in comparison to peers, even as compared to those with specific learning disorders (Reaser et al. 2007). Such differences likely eventually contribute to problems in vocational functioning (Hill and Petty 1995; Sibley et al. 2012), a type of impairment that becomes increasingly evident as ADHD adolescents grow into adults and take on jobs requiring more skill and responsibility (Barkley 2006). These vocational problems include higher rates of being fired or laid off (Barkley et al. 2006), lower levels of full-time employment, and higher unemployment (Able et al. 2007; Das et al. 2012), as compared to the general population.

In addition, individuals with ADHD of all ages tend to experience significant social impairment (Kofler et al. 2011; Wehmeier et al. 2010). While ADHD-related social difficulties usually begin in childhood (Hoza et al. 2005) and have been found to continue into adolescence, it is becoming clear that affected adults also suffer relationally (Canu et al. 2013; Das et al. 2012; Kooij et al. 2005; Weiss and Murray 2003), tending to have difficulty forming and maintaining relationships (Barkley 2006; Weiss and Murray 2003; Young and Gudjonsson 2006). ADHD has also been linked to problematic behaviors that can have long-term effects on physical health. ADHD symptoms have been consistently and positively associated with cigarette consumption (Whalen et al. 2003), alcohol and drug abuse (Murphy and Barkley 1996), and

unhealthy eating (Davis et al. 2006) and even obesity (Altfas 2002; Waring and Lapane 2008). Emotional dysphoria has also been established as a common experience for adults with ADHD, who commonly report substantial symptoms of anxiety and depression (Able et al. 2007; Das et al. 2012; Friedrichs et al. 2012; Kooij et al. 2005; Young and Gudjonsson 2006).

As noted above, published findings regarding the effects of SCT on adjustment in adults, with or without ADHD, is scarce. Barkley's (2012) findings in a large, representative community sample of adults, clearly suggest that SCT, alone, contributes to impairment across several domains of life (e.g., social relationships, work, self-care), and in combination with ADHD often predicts even greater dysfunction. Other research has suggested that the presence of IA and SCT symptoms, but not HI symptoms, are predictive of higher perceived stress in adults (Combs et al. 2012), a finding which further emphasizes the importance of further examination into how these symptoms affect quality of life in adulthood.

Summary and Rationale for the Current Study

This study aimed to extend the literature by examining the impact that ADHD and SCT symptomatology has on QOL in a community sample of emerging to elderly adults. Specifically, four aspects of QOL were assessed: health (e.g., physical functioning), psychological (e.g., emotional functioning), social (e.g., satisfaction with social support), and environmental (e.g., satisfaction with interactions with one's surroundings, including living circumstances). Based on previous research, a negative relationship was expected between the level of ADHD traits (i.e., inattention, hyperactivity-impulsivity) and sluggish cognitive tempo symptoms and each index of QOL.

Method

Participants

A sample of 1,044 non-clinical, community participants from western North Carolina took part in a randomized medical trial examining the effects of an antioxidant regimen on cognitive and psychological outcomes (Broman-Fulks et al. 2012; Combs et al. 2012). Nine-hundred-eighty-three of these participants (94.2 % of original sample) completed measures examined herein at baseline, and are included in the current sample. The majority were (60.7 %) female and almost all (95.6 %) were Caucasian. Almost half were in "middle age" (18−40 years old; 49.9 %), with 37.6 % considered "young adult" (ages 18−40) and 12.4 % "retirement age" (ages 66−85). The sample was above average in educational attainment, with 81.6 % having completed at least some college. Additional details regarding the sample's demographic composition are in Table 1.

Procedure

Four-hundred-seventy-three participants composed an initial cohort (Spring 2008) and 510 people participating in the second cohort (Fall 2008). After giving written informed

Table 1 Descriptive statistics: demographic, independent, and dependent variables

Variable	Descriptive/*M* (*SD*)	Observed range	Maximum scores
Gender	60.7 % female		
Age	45.56 (16.19) years	18–85	
Education	15.53 (2.8) years	2–20	
Depression	52.35 (10.09)	0–80	80
Anxiety	51.21 (10.59)	0–80	80
IA	5.14 (4.13)	0–26	27
HI	4.92 (3.79)	0–27	27
SCT	2.27 (1.79)	0–9	9
QOL total	72.62 (9.60)	32–93	93
QOL phys.	28.80 (4.16)	10–35	35
QOL psych.	19.25 (2.91)	5–25	25
QOL social	11.50 (2.16)	3–15	15
QOL envir.	19.50 (2.83)	6–25	25

IA DSM-IV inattention scale score; *HI* DSM-IV hyperactivity/impulsivity scale score; *SCT* sluggish cognitive tempo scale score; *QOL Total* quality of life total scale score; *QOL Phys*. physical quality of life scale score; *QOL Psych*. psychological quality of life scale score; *QOL Social* social quality of life scale score; *QOL Envir*. environmental quality of life scale score

consent, participants completed baseline questionnaires and rating scales, including symptom assessment and QOL measures (see below). While most completed these online, a small proportion of the sample (<10 %) completed the measures in a computer laboratory during the course of their baseline visit, due to limited internet access or familiarity with online forms.

Measures

Current Symptom Scale (CSS) This self-report measure consists of 18 items tapping the inattentive and hyperactive-impulsive symptoms of ADHD as defined in the *DSM-IV-TR* (APA 2000), and referencing the past 6 months (Barkley and Murphy 2006). Responses are provided on a four-point Likert-type scale (0 = *never or rarely*; 3 = *very often*). Two subscales of nine items each tap *DSM-IV-TR* indexed hyperactivity-impulsivity (HI; e.g., *had difficulty awaiting* turn) and inattention (IA; e.g., *lost things necessary for tasks or activities*). In addition, three items tapping sluggish cognitive tempo (*felt confused or* "*lost in a fog*," *daydreamed or got lost in my thoughts, felt sluggish or drowsy*) that are consistent in number and content to other studies tapping SCT and an existent factor analysis identifying SCT items (see review in Lee et al. 2013) were added. In the current sample, internal reliability for all scales was satisfactory (α=.86 [IA], .78 [HI], .73 [SCT]).

World Health Organization Quality of Life Questionnaire, Brief Form (WHOQOL-BREF) This self-report measure examines current (past 2 weeks) quality of life in four domains (Bonomi et al. 2000): physical health (7 items; e.g., *How well are you able to get around?*), psychological health (6 items; e.g., *To what extent do you feel your life to be meaningful?*), social relationships (3 items; e.g., *How satisfied are you with your personal relationships?*), and environmental factors (8 items; e.g., *Have you enough money to meet your needs?*). Responses are on a five-point scale (1 = *Not at all* to 5 = *Extremely*); items are summed to achieve raw domain scores, with higher scores indicating better QOL.

Two additional items tap general QOL (i.e., *How would you rate your quality of life*") and general health (i.e., *How satisfied are you with your health?*), and are included in the total scale sum score. A 19-item version of the WHOQOL-BREF was employed in the first cohort, whereas the full 26-item scale was utilized with the second. The short form included abbreviated psychological (five items) and environmental (five item) subscales, the full physical subscale, and omitted the social subscale. Correlations between the abbreviated and full psychological and environmental subscales in the second cohort were excellent (r=.86 and .80, respectively). As such, scores for psychological and environmental subscales in the second cohort were calculated using the five-item versions, for consistency across the sample. Findings reported regarding social QOL necessarily reflect only cohort two data (n=510). Given their length, internal reliability for the scales used herein was found to be adequate (Physical α=.63, Psychological = .78, Social = .68, Environmental = .73); this keeps with prior research suggesting satisfactory internal consistency (domain αs>.7; Huang et al. 2006).

Brief Symptom Inventory (BSI; Derogatis 1993) This 53-item, self-report measure consists of nine scales and three global indices designed to assess presence and severity of a variety of psychological issues. Symptoms are assessed by frequency or severity of symptom experience on a five-point Likert-type scale (0 = *Not at all*, 4 = *Extremely*). *T* scores calculated based on non-patient norms (Derogatis 1993) by sex are reported herein. The BSI has demonstrated satisfactory internal consistency and test-retest reliability for both the depression and anxiety scales (α=.85, .81 and .84, .79, respectively; Derogatis 1993). Internal reliability for the six-item Depression and Anxiety scales used herein were similarly satisfactory (.87 and .78, respectively).

Data Analytic Strategy

The primary analyses were hierarchical multiple regressions using nine predictor variables, entered in three blocks as follows: Block One, age, sex (coded: male = 1, female = 2), and education level (coded: ended school in 5th−8th grade = 1, 9th−12th grade = 2, some college = 3, 4 years of college = 4, more than 4 years of college = 5); Block Two, BSI Depression and Anxiety scale scores; Block Three, ADHD IA, ADHD HI, and SCT symptoms. The use of three predictor blocks maximizes power for variables in each block; concrete hypotheses (i.e., that ADHD and SCT symptoms will negatively relate to QOL indices) are tested in the third block. Five separate regressions were run to examine the independent associations of the respective predictors on the following dependent variables: Total, physical, psychological, social, and environmental QOL.

Results

Multivariate analyses of variance (MANOVAs) were employed to determine if differences existed between the first and second cohorts on both independent, Wilks' Lambda, Λ=.98, F (8, 932) = 2.31, p=.02, and dependent variables, Λ=.43, F (5, 975) = 256.82, p<.001. Follow-up analyses indicated that the cohorts statistically differed from one another on age (an IValready included in block one of the

regression model) and total QOL, with cohort one displaying higher total QOL and cohort two higher overall age. In order to exert some statistical control for potential cohort differences, a dichotomous variable corresponding to cohort number (coded as 1 or 2) was added to those planned for the first block of each hierarchical regression,[1] allowing for independent ascertainment of variance attributable to other predictor variables.

Table 2 depicts the zero-order correlations between variables of interest, and Table 3 presents the basic statistical results from the five hierarchical regression analyses. In the analyses predicting total, physical, psychological, and environmental QOL, each of the three steps added statistically significant predictive power. In the final regression examining social QOL (using data from cohort two, alone), only the second step added statistically significant predictive power. Regarding total QOL, specifically, six individual independent variables emerged as statistically significant predictors. Cohort, depression, anxiety, IA, and SCT were all negatively associated with participants' total QOL. Education, however, served as a positive predictor.

Regarding domain-specific QOL associations, four independent variables served as statistically significant predictors of physical QOL. SCT, age, and depression were all negatively associated with physical QOL, while education, again, served as a positive predictor of this outcome. Psychological QOL was also associated with five predictor variables. Depression, IA, and SCT, were all negatively associated with participants psychological QOL scores. Education, again, had a positive association with this variable, and female participants tended to report lower psychological QOL as compared to males. For environmental QOL, only four independent predictors emerged as statistically significant: Depression and IA (negative), and education and age (positive). Finally, only Depression emerged as a significant, negative predictor of social QOL.

Exploratory Analyses

SCT has rarely been included in the examination of impairment in adulthood, and the meaningful associations between this construct and both physical and psychological QOL prompted post-hoc tests to add detail to these relationships. Specifically, simple linear regressions of SCT on the individual item scores for these two QOL subscales were performed; Table 4 presents the statistical results of these analyses. SCT emerged as a significant predictor ($p<.001$) for five out of seven items on the physical QOL subscale. These included "Do you have enough energy for daily life?", "How well are you able to get around?", "How satisfied are you with your sleep?", "How satisfied are you with your ability to perform your daily living activities?", and "How satisfied are you with your capacity for work?" In addition, SCT was significantly associated with *every* item on the psychological QOL subscale ($p<.001$), demonstrating a predictive relationship between SCT and all of this subscale's constructs (i.e., life enjoyment, life meaning, ability to concentrate, bodily acceptance, and self-satisfaction).

Additionally, exploratory hierarchical regressions, identical in format to the primary analyses detailed above, were conducted using younger (M age = 31.9 [8.9]) and older (M age = 58.5 [9.3]) mean-split subsamples to examine whether the pattern of

[1] Except for social QOL, given that herein this subscale was not included in the total QOL calculation (see Measures, above).

Table 2 Correlation matrix of independent and dependent variables

Variables	Age	Gender	Education	Depression	Anxiety	IA	HI	SCT	QOL total	QOL phys.	QOL psych.	QOL social	QOL envir.
Gender	0.02												
Education	.08*	−0.01											
Depression	−0.04	−0.03	−0.04										
Anxiety	−0.03	−0.04	−0.04	.66**									
IA	−0.04	.08**	0.04	.37**	.38**								
HI	−.20**	.11**	0.02	.26**	.37**	.66**							
SCT	−.16**	.09**	−0.04	.42**	.39**	.72**	.59**						
QOL total	0	−0.05	.18**	−.46**	−.38**	−.40**	−.29**	−.44**					
QOL phys.	−.10**	−0.03	.10**	−.29**	−.27**	−.27**	−.23**	−.30**	.60**				
QOL psych.	0.02	−.11**	.11**	−.51**	−.36**	−.42**	−.28**	−.43**	.83**	.48**			
QOL social	0.01	0.01	0.02	−.19**	−.14**	−.16**	−.12**	−.17**	.39**	.40**	.38**		
QOL envir.	.14**	−0.01	.24**	−.38**	−.31**	−.27**	−.22**	−.30**	.76**	.39**	.59**	.28**	

IA inattention; *HI* hyperactivity impulsivity, *SCT* sluggish cognitive tempo

*p<.05; **p<.01

Table 3 Hierarchical multiple regression analyses predicting total and domain-specific Quality of Life (QOL) outcomes

Predictor	Predicted aspect of QOL									
	Total		Physical		Psychological		Environmental		Social	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.12***		.03***		.06***		.06***		.001	
Control variables[a]										
Step 2	.26***		.10***		.30***		.16***		.07***	
BSI depression		−.41***		−.22***		−.49***		−.32***		−.23***
BSI anxiety		−.15*		−.14***		−.08*		−.11**		−.04
Step 3	.06***		.04***		.05***		.02***		.01	
ADHD IA		−.20***		−.03		−.17***		−.10*		−.03
ADHD HI		.02		−.08		.04		−.002		.003
SCT		−.14***		−.15**		−.13**		−.07		−.09
Total R^2	.44***		.16***		.37***		.22***		.06	

BSI brief symptom inventory. *ADHD* attention-deficit/hyperactivity disorder. *IA* inattention. *HI* hyperactivity/impulsivity. *SCT* sluggish cognitive tempo. *B-ADHD* Barkley's adult ADHD criteria

* $p<.05$; ** $p<.01$; *** $p<.001$

[a] Control variables are age, sex, education level

Table 4 Linear regression analyses of Sluggish Cognitive Tempo (SCT) on World Health Organization Quality of Life (QOL) items for physical and psychological QOL domains

QOL scale items	SCT		
Physical QOL	*B*	*SE B*	β
To what extent do you feel that physical pain prevents you from doing what you need to do?	−.02	.03	−.02
How much do you need any medical treatment to function in your daily life?	.001	.03	.001
Do you have enough energy for everyday life?	−.22	.01	−.46***
How well are you able to get around?	−.07	.01	−.18***
How satisfied are you with your sleep?	−.17	.02	−.29***
How satisfied are you with your ability to perform your daily living activities?	−.14	.01	−.32***
How satisfied are you with your capacity for work?	−.16	.01	−.34***
Psychological QOL			
How much do you enjoy life?	−.11	.01	−.27***
To what extent do you feel your life to be meaningful?	−.10	.01	−.22***
How well are you able to concentrate?	−.19	.01	−.46***
Are you able to accept your bodily appearance?	−.14	.02	−.20***
How satisfied are you with yourself?	−.16	.01	−.35***

SCT sluggish cognitive tempo

*** $p<.001$

associations between dependent and independent variables varied systematically across broad age groups. Few differences[2] were noted, overall, and as such the full-sample results were taken to best represent underlying relationships.

Discussion

Overall, these findings suggest that sluggish cognitive tempo *and* ADHD symptomatology play roles in the quality of life of adults of all ages, over and above mood- and anxiety-related distress and controlling for several key demographic variables. Notably, SCT emerged as a frequent predictor of lower QOL, even in the presence of the often co-occurring ADHD symptoms.

Inattention Effects

ADHD-related inattention predicted two QOL domains, appearing to be strongly related to lower *psychological* QOL—consistent with prior research (Das et al. 2012)—and only moderately related to *environmental* QOL. Ample research already suggests that ADHD symptoms are related to increased prevalence of anxiety, depression, and other psychological disorders in both children and adults (Barkley 2006; Das et al. 2012; Kooij et al. 2005; Waring and Lapane 2008). Further, inattention has been more broadly linked to academic (Riley et al. 2006) and interpersonal difficulties (Canu and Carlson 2007), as well as to lower life satisfaction, lower achievement (Riley et al. 2006), and vulnerability for the development of low self-esteem and other emotional problems (Barkley 2006; Waring and Lapane 2008). In addition, IA predicted psychological functioning over and above what could be accounted for by general mood disturbance as assessed by control variables (BSI depression and anxiety scores).[3] Together, these circumstances make this particular finding more meaningful, as it suggests a broader impact of IA on psychological functioning.

There is limited information linking adult ADHD traits to QOL, but this is especially true for environmental aspects of QOL. The finding in this study that IA negatively predicts this aspect of QOL is unique, and especially interesting given that IA remains a significant predictor even when controlling for the influence of higher education (a significant positive predictor of environmental QOL). Given the likelihood that individuals in our sample who are at the high end of the ADHD IA and HI spectrum suffer some educational impairment, the effect of ADHD symptoms *over and above* such ADHD-related *impairment* (i.e., lower educational attainment) is particularly meaningful. Although only two of the specific QOL domains were related in this sample to IA, it was also negatively related to *overall* QOL. It is possible, therefore, that specific aspects of quality of life in all of the different domains do relate to IA, even if IA was not associated with those respective subscales, more generally. That IA predicts lower overall levels of QOL underscores this possibility.

[2] In the hierarchical regression on physical QOL, HI was an additional, modest predictor ($\beta = -.13$, $p = .024$) in Block 3 for the older subsample; for psychological QOL, SCT ($\beta = -.19$, $p = .002$) emerged as a predictor in Block 3 for younger adults, whereas IA ($\beta = -.21$, $p < .001$) did so for older adults.

[3] Note: The shortened version of the psychological QOL subscale employed in this study omitted an item that directly tapped current depression and anxiety.

The lack of association between IA and the other areas of QOL was surprising, particularly given population-based studies documenting associations with wide-ranging impairments in affected adults (Das et al. 2012; Kooij et al. 2005), but may be at least partially explained by the qualities of the other subscales themselves. For example, the physical QOL subscale fails to tap IA-related physical vulnerabilities and instead focuses on more general physical functioning in daily life (i.e., general ability for movement, capacity for work, presence of physical pain).

Sluggish Cognitive Tempo (SCT) Effects

In this study, SCT predicted lower physical, psychological, and overall QOL. The literature linking SCT to constructs of QOL is extremely limited, and, as such, this research adds meaningfully to the literature. However, without much previous research to aid interpretation of these findings, *post-hoc* analysis seemed desirable. Accordingly, linear regression analyses were used to examine how SCT related to the individual WHOQOL items. These are discussed below, ancillary to discussion of the initial multiple regression analyses examining domain-level data.

The current findings show SCT to negatively predict physical QOL, an outcome that may indicate a chronic liability for adults with these persistent ADHD-related symptoms to experience negative physical consequences. Interestingly, SCT appears to be linked to specific physical impairments in adults, including energy level, capacity for work, ability to perform daily activities, sleep satisfaction, and mobility. Given these relationships, it is not surprising that SCT is also negatively related to subjective psychological well-being, which corresponds with prior research linking SCT with negative emotional outcomes (see Barkley 2006; Combs et al. 2012). This may emphasize the vulnerability of individuals with Predominantly Inattentive ADHD (ADHD-IA) to poor psychological QOL, as the presence of SCT symptoms, which most commonly occurs in ADHD-IA cases, appears to increase the risk associated with IA alone (see above). By extension, because SCT appears to strongly predict physical and psychological QOL (ßs=−.16, −.15, respectively), it is not surprising that it negatively predicts total QOL, as well. Although research directly linking SCT to QOL variables is limited, the current findings seem to converge with the overall trend in the literature linking SCT with negative emotional and life outcomes (e.g., Barkley 2012; Carlson and Mann 2002; Combs et al. 2012).

Hyperactivity-Impulsivity Effects

Interestingly, HI did not serve as a significant predictor for any aspect of QOL except physical QOL in the older adult subsample. Given that the sample used in this study consisted of adults, and recognizing that IA traits are more likely than HI to persist (Barkley 2006; Biederman et al. 2000; Solanto et al. 2012; exception in Kooij et al. 2005), perhaps there was a lower proportion in this sample that truly had the very elevated HI that would best predict broad impairment. To consider this, an examination of the distribution of scores in this sample relative to conservative, published norms for young adults (i.e., + 1.5 *SD* clinical cutoff for 17–29 year old males; Barkley and Murphy 2006) was implemented in order to determine, as compared to a substantially younger, independent sample (current participants' *M* age = 45.56 years), what the

prevalence of persistently elevated HI and IA is. The percentage of individuals in the sample who met these conservative criteria for elevated IA symptoms is 4.4 %, while only 1.3 % reported elevated HI symptoms, which contrasts some other population-based findings (Kooij et al. 2005) and supports the suggestion that HI may possibly be less prevalent than IA in later life.

Limitations and Future Directions

Diversity of the sample was limited, consisting of predominantly Caucasian individuals (95.3 %). Future research might determine if the findings of this study can be replicated among a more diverse sample. In addition, the study relied on a non-clinical, community sample, using continuous ADHD traits as predictors instead of actual ADHD diagnoses. The percentage of participants who met a clinical criterion for elevated (i.e., ≥ 93rd percentile) IA symptoms was 4.4 %, while 1.3 % reported elevated HI symptoms, rates that are comparable to the general prevalence of ADHD in adults as determined by national epidemiological research (e.g., Kessler et al. 2006). However, it is likely that some in the current "above-clinical-threshold" group, identified by self-report only, would not technically be diagnosed with ADHD via more rigorous methods. As such, it is difficult to know the true prevalence of ADHD in this sample and, therefore, how closely the findings may generalize to the population at large. Further, while the statistical procedures used herein accounted for the influence of anxious and depressive symptomatology on QOL, independent of ADHD and SCT, the influence of *true* comorbidity (e.g., major depressive disorder, specific or social phobias) on QOL cannot be accounted for using the current data. The data presented therein, however, clearly corroborate how mood and anxiety problems exacerbate negative QOL. As those with ADHD tend to experience higher rates of related disorders than the general population (see review in Brown 2008), future studies could productively target clinical assessment of such comorbidity and examine its influence relative to ADHD and SCT. In addition, a majority (~60 %) of the current sample were female, a characteristic that may have potentially affected study outcomes, particularly given established trends demonstrating ADHD traits to be more prevalent in males (Kessler et al. 2006). Therefore, while sex was included in the hierarchical regression analyses reported herein, providing some control for its influence on QOL, the distribution of SCT and ADHD traits in this sample may not be comparable to a more general population where males and females are sampled equally.

For this study, the full social QOL scale was administered to the second cohort, only, which, to some extent, limits the power for analysis of ADHD's relationship to this particular domain of QOL. In addition, an abbreviated, 19-item version of the physical, psychological, and environmental QOL scales was utilized, corresponding to the items included in the cohort one questionnaire and excluding seven others. Although the shortened and original scales are significantly and positively correlated with one another, these differences in measure construction may have contributed to the predictive power of cohort in predicting total QOL.

Studies linking SCT with adult life outcomes are sparse, which leaves little foundation for interpretation of the lack of significant relationship between SCT and social or environmental QOL. Although the results of this study do not suggest social or environmental QOL impairment for adults with elevated

SCT, future research should explore this possible link further in order to determine if individuals with ADHD-IA, and especially those with additional symptoms of SCT, may be at particular risk for social or environmental dissatisfaction.

Although these limitations to the current study deserve consideration, the sample size and age range of the sample are salient strengths. As previously mentioned, many studies focusing on ADHD life outcomes—and SCT outcomes, in particular—utilize relatively small samples of children. In fact, no prior study of QOL related to ADHD symptoms has utilized such a broad age-range of adults (18 to 85 years old). Although this study examines ADHD traits as opposed to clinical ADHD diagnoses, the current findings thereby extend the published literature.

Conclusion

The cumulative findings clearly suggest that SCT, along with specific ADHD traits in adulthood, impacts areas of life satisfaction and adjustment, and contribute to the body of knowledge concerning life outcomes of adults with ADHD and related symptoms. SCT is not a component of any formal *DSM-5* criteria set, yet has been noted to often exist concurrent to ADHD-IA, and thus may disproportionately add to dysfunction experienced by individuals with that specific diagnosis and go unrecognized as a contributing factor. The current findings suggest, however, that even SCT alone is likely to negatively impact quality of life in adulthood, which is consistent with other recent research documenting a similar pattern in functional impairments (Barkley 2012). SCT has been predominantly studied in children, and a recent review has highlighted how monitoring this trait, distinct from ADHD, is important to effectively identify and address related mood, social, and academic dysfunction (Becker 2013). Given preliminary indications of how often SCT co-occurs with ADHD in adults (e.g., 54 % of those high in SCT also qualifying for ADHD diagnosis; Barkley 2012), it is impossible to know what degree SCT comorbidity might have accounted for dysfunction noted in prior population- and clinic-based studies. By extension and in light of the data presented herein, incorporating SCT into standard psychological assessment and treatment outcome research in adults is indicated. Another important direction for future research would be to prospectively follow the impact of SCT on various adult life outcomes. Areas such as sleep satisfaction, physical functioning, mood, information processing, self-esteem, and social satisfaction, as well as financial and environmental hardship, would be appropriate to track to examine whether SCT has pervasive negative impact. In general, the findings reinforce recent calls to consider SCT as part of the constellation of impairing neurodevelopmental conditions (Barkley 2012; Becker 2013), and underscore how both SCT and ADHD are likely to continue to negatively impact affected individuals across the lifespan.

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References

Able, S. L., Johnston, J. A., Adler, L. A., & Swindle, R. W. (2007). Functional and psychosocial impairment in adults with undiagnosed ADHD. *Psychological Medicine, 37*, 97–107. doi:10.1017/S0033291706008713.

Agarwal, R., Goldenberg, M., Perry, R., & Ishak, W. W. (2012). The quality of life of adults with attention deficit hyperactivity disorder: a systematic review. *Innovation in Clinical Neuroscience, 9*, 10–21.

Altfas, J. R. (2002). Prevalence of attention deficit/hyperactivity disorder among adults in obesity treatment. *BMC Psychiatry, 2*, 1–8. Retrieved from http://www.biomedcentral.com/1471-244X/2/9.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Barkley, R. (2006). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (3rd ed.). New York: Guilford Press.

Barkley, R. A. (2012). Distinguishing sluggish cognitive tempo from attention-deficit/hyperactivity disorder in adults. *Journal of Abnormal Psychology, 121*, 978–990. doi:10.1037/a0023961.

Barkley, R., & Murphy, K. (2006). *Attention- deficit hyperactivity disorder: A clinical workbook* (3rd ed.). New York: Guilford.

Barkley, R., Fischer, M., Smallish, L., & Fletcher, K. (2006). Young adult outcomes of hyperactive children: adaptive functioning in major life activities. *Journal of the American Academy of Child and Adolescent Psychiatry, 45*, 192–202. doi:10.1097/01.chi.0000189134.97436.e2.

Becker, S. P. (2013). Topical review: sluggish cognitive tempo: research findings and relevance for pediatric psychology. *Journal of Pediatric Psychology*. Advance online publication. doi:10.1093/jpepsy/jsto58.

Biederman, J., Mick, E., & Faraone, S. V. (2000). Age-dependent decline of symptoms of attention deficit hyperactivity disorder: impact of remission definition and symptom type. *American Journal of Psychiatry, 157*, 816–818. doi:10.1176/appi.ajp.157.5.816.

Biederman, J., Petty, C., Evans, M., Small, J., & Faraone, S. (2010). A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Research, 177*, 299–304. doi:10.1016/j.psychres.2009.12.010.

Bonomi, A. E., Patrick, D. L., Bushnell, D. M., & Martin, M. (2000). Validation of the United States' version of the World Health Organization Quality of Life (WHOQOL- BREF) instrument. *Journal of Clinical Epidemiology, 53*, 13–17.

Broman-Fulks, J. J., Canu, W. H., Trout, K. L., & Nieman, D. C. (2012). The effects of quercetin supplementation on cognitive functioning in a community sample: a randomized, placebo-controlled trial. *Therapeutic Advances in Psychopharmacology, 2*(4), 131–138. doi:10.1177/204512531244589.

Brown, T. (2008). *ADHD comorbidities: Handbook for ADHD complications in children and adults*. Arlington: American Psychiatric Publishing.

Canu, W. H., & Carlson, C. L. (2007). Rejection sensitivity and social outcomes of young adult men with ADHD. *Journal of Attention Disorders, 10*, 261–275. doi:10.1177/1087054706288106.

Canu, W. H., Tabor, L. S., Michael, K. D., Bazzini, D. G., Elmore, A. E. (2013). Romantic couples' conflict resolution and satisfaction varies with partner's attention-deficit/hyperactivity disorder type. *Journal of Marital and Family Therapy*. Advance online publication. doi:10.1111/jmft.12018.

Carlson, C. L., & Mann, M. (2002). Sluggish cognitive tempo predicts a different pattern of impairment in the attention-deficit/hyperactivity disorder, predominantly inattentive type. *Journal of Clinical Child and Adolescent Psychology, 31*, 123–129. doi:10.1207/S15374424JCCP3101_14.

Centers for Disease Control and Prevention (2009). *Health related quality of life*. Retrieved May 10, 2009 from http://www.cdc.gov/hrqol/.

Combs, M. A., Canu, W. H., Broman-Fulks, J. J. Rocheleau, C. A., Nieman, D. C. (2012). Perceived stress and ADHD symptoms in adults. *Journal of Attention Disorders*. Advance online publication. doi:10.1177/1087054712459558.

Das, D., Cherbuin, N., Butterworth, P., Anstey, K. J., & Easteal, S. (2012). A population-based study of attention deficit/hyperactivity disorder symptoms and associated impairment in middle-aged adults. *PLoS One, 7*, e31500. doi:10.1371/journal.pone.0031500.

Davis, C., Levitan, R. D., Smith, M., Tweed, S., & Curtis, C. (2006). Associations among overeating, overweight, and attention-deficit/hyperactivity disorder: a structural equation modeling approach. *Eating Behaviors, 7*, 266–274. doi:10.1016/j.eatbeh.2005.09.006.

Derogatis, L. R. (1993). *Brief symptom inventory (BSI): Administration, scoring, and procedures manual*. Minneapolis: Pearson.

Friedrichs, B., Igl, W., Larsson, H., & Larsson, J.-O. (2012). Coexisting psychiatric problems and stressful life events in adults with symptoms of ADHD—a large Swedish population-based study of twins. *Journal of Attention Disorders, 16*, 13–22. doi:10.1177/1087054710376909.

Garner, A. A., Marceaux, J. C., Mrug, S., Patterson, C., & Hodgens, B. (2010). Dimensions and correlates of attention deficit/hyperactivity disorder and sluggish cognitive tempo. *Journal of Abnormal Child Psychology, 38*, 1097−1107. doi:10.1007/s10802-010-9436-8.

Hill, R. B., & Petty, G. C. (1995). A new look at selected employability skills: a factor analysis of the occupational work ethic. *Journal of Vocational Education Research, 20*, 59−73.

Hoza, B., Mrug, S., Gerdes, A. C., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., . . . Arnold, L. E. (2005). What aspects of peer relationships are impaired in children with attention-deficit/hyperactivity disorder? *Journal of Counseling and Clinical Psychology, 73*, 411−423. doi:10.1037/0022-006X.73.3.411.

Huang, I., Wu, A., & Frangakis, C. (2006). Do the SF-36 and WHOQOL-BREF measure the same constructs? Evidence from the Taiwan population. *Quality of Life Research, 15*, 15−24. doi:10.1007/s11136-005-8486-9.

Kessler, R. C., Adler, L., Barkley, R. O., Biederman, J., Connors, C. K., & Demler, O. (2006). The prevalence and correlates of ADHD in the United States: results from the National Comorbidity Survey Replication (NCS-R). *American Journal of Psychiatry, 163*, 716−723.

Kofler, M. J., Rapport, M. D., Bolden, J., Sarver, D. E., Raiker, J. S., & Alderson, R. M. (2011). Working memory deficits and social problems in children with ADHD. *Journal of Abnormal Child Psychology, 39*, 805−817. doi:10.1007/s10802-01109492-8.

Kooij, J. J. S., Buitelaar, J. K., Van Den Oord, E. J., Furer, J. W., Rijnders, C. A. T., & Hodiamont, P. P. G. (2005). Internal and external validity of attention-deficit hyperactivity disorder in a population-based sample of adults. *Psychological Medicine, 35*, 817−827. doi:10.1017/S003329170400337X.

Lee, S., Burns, G. L., Snell, J., McBurnett, K. (2013). Validity of the sluggish cognitive tempo symptom dimension in children: sluggish cognitive tempo and ADHD-inattention as distinct symptom dimensions. *Journal of Abnormal Child Psychology*, Advance online publication. doi:10.1007/s10802-013-9714-3.

Lensing, M. B., Zeiner, P., Sandvik, L., Opjordsmoen, S. (2013). Quality of life in adults aged 50+ with ADHD. *Journal of Attention Disorders*. Advance online publication. http://jad.sagepub.com/.

Loe, I. M., Balestrino, M. D., Phelps, R. A., Kurs-Lasky, M., Chaves-Gnecco, D., Paradise, J. L., et al. (2008). Early histories of school-aged children with attention-deficit/hyperactivity disorder. *Child Development, 79*, 1853−1868.

Marshall, S. A., Evans, S. W., Eiraldi, R. B., Becker, S. P., Power, T. J. (2013). Social and academic impairment in youth with ADHD, predominantly inattentive type and sluggish cognitive tempo. *Journal of Abnormal Child Psychology*. Advance online publication. doi:10.1007/s10802-013-9758-4.

McBurnett, K., Pfiffner, L. J., & Frick, P. J. (2001). Symptom properties as a function of ADHD type: an argument for continued study of sluggish cognitive tempo. *Journal Of Abnormal Child Psychology, 29*(3), 207−213. doi:10.1023/A:1010377530749.

McConaughy, S. H., Volpe, R. J., Antshel, K. M., Gordon, M., & Eiraldi, R. B. (2011). Academic and social impairments of elementary school children with attention deficit hyperactivity disorder. *School Psychology Review, 40*, 200−225.

Murphy, K., & Barkley, R. A. (1996). Attention deficit hyperactivity disorder comorbidities and adaptive impairments. *Comprehensive Psychiatry, 37*, 393−401.

Reaser, A., Prevatt, F., Petscher, Y., & Proctor, B. (2007). The learning and study strategies of college students with ADHD. *Psychology in the Schools, 44*, 627−638. doi:10.1002/pits.20252.

Riley, A., Spiel, G., Coghill, D., Dopfner, M., Falissard, B., Lorenzo, M., . . . Ralston, S. J. (2006). Factors related to health-related quality of life (HRQoL) among children with ADHD in Europe at entry into treatment. *European Child Adolescent Psychiatry, 15*, 38−45. doi:10.1007/s00787-006-1006-9.

Sibley, M. H., Pelham, W. E., Molina, B., Gnagy, E. M., Waxmonsky, J. G., Waschbusch, D. A., . . . Kuriyan, A. B. (2012). When diagnosing ADHD in young adults emphasize informant reports, DSM items, and impairment. *Journal of Consulting and Clinical Psychology*, Advance online publication. doi:10.1037/a0029098.

Sobanski, E., Schredl, M., Kettler, N., & Alm, B. (2008). Sleep in adults with attention deficit hyperactivity disorder (ADHD) before and during treatment with methylphenidate: a controlled polysomnographic study. *Sleep, 31*, 375−381.

Solanto, M. V., Wasserstein, J., Marks, D. J., & Mitchell, K. J. (2012). Diagnosis of ADHD in adults: what is the appropriate DSM-5 symptom threshold for hyperactivity-impulsivity? *Journal of Attention Disorders, 16*, 631−634. doi:10.1177/1087054711416910.

Waring, M. E., & Lapane, K. L. (2008). Overweight in children and adolescents in relation to attention-deficit/hyperactivity disorder: results from a national sample. *Pediatrics, 122*, 1−6. doi:10.1542/peds.2007-1955.

Wehmeier, P. M., Schacht, A., & Barkley, R. A. (2010). Social and emotional impairment in children and adolescents with ADHD and the impact on quality of life. *Journal of Adolescent Health, 46*, 209−217. doi:10.1016/j.jadohealth.2009.09.009.

Weiss, M., & Murray, C. (2003). Assessment and management of attention-deficit hyperactivity disorder in adults. *Canadian Medical Association Journal, 168*, 714−722.

Whalen, C., Jamner, L., Henker, B., Gehricke, J., & King, P. (2003). Is there a link between adolescent cigarette smoking and pharmacotherapy for ADHD? *Psychology of Addictive Behaviors, 17*, 332−335. doi:10.1037/0893-164X.17.4.332.

Young, S., & Gudjonsson, G. (2006). ADHD symptomatology and its relationship with emotional, social, and delinquency problems. *Psychology, Crime & Law, 12*, 463−471. doi:10.1080/10683160500151183.